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SCIENTIFIC INTELLIGENCE REPORT

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A POSSIBLE ESV TRACKING RADAR
NEAR KRASNOVODSK

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PREFACE

This Scientific Intelligence Report is based on photo interpretation of CHES material at HTAUTOMAT, reported in Joint Army, Navy, CIA Photo Intelligence Memorandum JM-4-57.

Detailed photo interpretation is continuing at HTAUTOMAT, but it is unlikely that analysis of presently available photography will reveal additional information which would alter the conclusions reached herein.

The acquisition of additional [] data from this installation would provide the basis for a much firmer estimate of the installation, its functions, technical characteristics, and capabilities.

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A POSSIBLE ESV TRACKING RADAR AT KRASNOVODSK

PROBLEM

To assess the significance of the electronics installation near Krasnovodsk, on the east coast of the Caspian Sea.

CONCLUSIONS

1. The large parabolic antenna structure near Krasnovodsk is probably the antenna for a long range radar for tracking Soviet Earth Satellite Vehicles. The location and orientation are suitable for detection of Soviet ESVs near the completion of their first orbit and at least once daily during the life of the satellites.
2. The beam from this antenna appears to have an azimuth direction of about 270 - 280 degrees. Scanning in azimuth appears unlikely but scanning in elevation is possible.
3. It is estimated that the operating frequency is between 100 mc/s and 600 mc/s with the most likely regions being around 200 mc/s or around 400 mc/s.
4. The maximum range at which this radar can detect an object the size of the first Soviet ESV is estimated to be 1500 to 2000 nautical miles.
5. Should further evidence confirm the Krasnovodsk installation as an ESV detecting radar, it must be concluded that the USSR has already made considerable progress in at least the warning aspects of ICBM defense.
6. Other possible, but less likely, applications of the large parabolic antenna include communications, television relay, or

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radio astronomy. Although there is evidence indicating that television rebroadcasting at Krasnovodsk has been accomplished, utilizing off-the-air pick-up from the primary television station at Baku, the parabolic antenna structure is much larger than necessary for such application.

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DISCUSSION

1. A large parabolic antenna structure has been located about three miles northwest of Krasnovodsk ($40^{\circ}02'26''N$ - $52^{\circ}57'13''E$) on the east coast of the Caspian Sea. This antenna, together with several buildings and a tower about 200 feet high for other antennas is located within a fenced area measuring about 615 x 915 feet. (See Plate #1)

2. The parabolic antenna is a fixed structure about 115 feet high with a total aperture of about 245 feet and is in the form of a cylindrical parabola intersected near its vertex by a plane. The structure, which is supported by cable guys, appears to be a steel grid framework probably supporting a wire mesh reflecting surface. (See Plate #2)

3. The direction of the antenna beam formed by this antenna appears to have an azimuth orientation of about 270° to 280° .

4. It appears that a suitable feed structure about 110 feet high is located at the focus of the parabolic section. Although it has not been possible to recover the details of this antenna feed system from available photography, the feed could be a vertical array composed of large electromagnetic horns.

5. The relative position of the feed to the reflector in-

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icates that the effective horizontal aperture of the antenna is probably about 200 feet. Further, it appears that the flat sheet section of the reflector which intersects the parabola probably does not contribute to the formation of the beam from the antenna, but instead is used to control side lobe radiation to the south of the antenna installation.

6. Since the antenna is fixed in azimuth, no mechanical azimuth scanning appears possible although lobe switching to improve azimuth resolution might be used. Scanning in elevation could be accomplished by phase shifting in the antenna feed system.

7. The most likely function of this installation is believed to be that of a radar for detecting and obtaining position data on the Soviet ESVs, which it should be able to do at least once each day during the life of the ESVs. In order to obtain position data on the Soviet ESVs as they approach the Soviet land mass upon completion of the first orbit, such a radar should be located in the southern USSR some 1000 miles from the path of the orbit with the antenna beam directed so that the ESVs would pass through it. The location and orientation of the antenna beam of the Krasnovodsk installation meet these requirements. This function is further supported by the existence of a rhombic communications antenna at Tyura Tam which is directed toward Krasnovodsk and the Soviet announcement of their intention to track their ESVs by radar when the signals cease.

8. The range required for radar detection of a Soviet ESV by the Krasnovodsk installation at the completion of its first orbit would be about 1000-1500 miles; it is estimated that the maxi-

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imum range of the radar could be about 2000 miles.

9. The conclusion that the Krasnovodsk installation is probably a radar for obtaining position data on the Soviets ESVs has been strongly influenced by both the existence of the ESVs, and Soviet published statements that they are tracking them by radar. In an earlier study by another agency it was concluded that this installation is a link in a new chain of communications under construction in Central Asia, that the large parabolic screen gathers audio and video signals of 50 to 60 megacycles from the television station at Baku, and that a television antenna in the self-supporting tower rebroadcasts these signals in the Krasnovodsk area /1 While there are several references in the open literature that experimental work has been conducted in an effort to establish a television link between Baku and Krasnovodsk and that Baku television programs have been successfully received in Krasnovodsk, /2, 3, 4 it is believed that an antenna the size of this large parabolic screen is wholly unnecessary for a television relay receiver at a distance of 143 miles which, for the most part, is over salt water. /5

/1. Detailed Photo Intelligence Report, No. T-57-22, November, 1957, USAF

/2. Izvestiya, No. 99, 21 August 1956, Pg. 4, col. 6

/3. FDD Summary #1068, 21 September 1956

/4. FBIS USSR and EE #60 1956

/5. TV Propagation Studies in the US have shown that television signals are attenuated over a salt water path to a lesser extent than over a land path.

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10. While dimensional data on the width of the antenna feed structure would provide a reasonable clue to the operating frequency, such detail does not appear to be recoverable from the available photography. Therefore, estimates of the operating frequency must be made through an indirect approach such as given in Appendix A. It is estimated that the operating frequency is probably between 100 - 600 mc/s with the most likely regions being around 200 mc/s or around 400 mc/s.

11. Should further evidence confirm the Krasnovodsk installation as an ESV detection radar, it must be concluded that the USSR has already made considerable progress in ICBM defense through the availability of, and experience with, radars capable of detecting and establishing ICBM trajectories.

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APPENDIX AThe Operating Frequency of the Krasnovodsk Radar

1. Since detailed photography sufficient to establish the critical dimensions of the radar for frequency determination is not available, the following process was employed to estimate the frequency.

2. The maximum frequency can be established by the requirement that the parabolic section should not deviate beyond about one-twentieth wavelength from a true parabola in order that the theoretical antenna gain from the structure be realized. The minimum frequency can be established by examining the effective radar reflection area of the target, the antenna gain and available transmitter output power.

3. The precision requirement in the reflector structure for realization of suitable antenna gain is given as follows:

<u>Frequency</u>	<u>Wavelength</u>	<u>Tolerance</u>
100 mc/s	3.0 meters	$\pm 6"$
200 mc/s	1.5 meters	$\pm 3"$
300 mc/s	1.0 meters	$\pm 2"$
400 mc/s	.75 meters	$\pm 1.5"$
600 mc/s	.5 meters	$\pm 1"$

The precision which can be achieved in a structure such as the Krasnovodsk installation, since it will be subject to wind loadings, is by no means clear. It appears to be braced entirely by tension members (guywires) with no compression members (braces) evident. It appears unlikely that a tolerance of less than $\pm 1"$ to $\pm 1.5"$ could

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be achieved and maintained with the structure.

4. The effect of the radar reflection cross-section of the target is particularly significant since the effective radar reflective area is highly frequency sensitive in the band being considered. The following table presents the calculated effective radar reflective areas assuming that the first Soviet ESV is a 22-inch conducting sphere (the antennas projecting from the sphere are ignored), as well as calculated antenna characteristics and transmitter power requirements.

<u>Frequency (Mc/s)</u>	<u>Beam Width - deg.</u>		<u>Gain - db</u>	<u>Eff. Radar Refl. Area* (sq. m.)</u>
	<u>Azim.</u>	<u>Elev.</u>		
100	3.45°	6.0°	31 db	.172
200	1.73°	3.0°	37.5	.885
300	1.15°	2.0°	40.5	.064
400	.86°	1.5°	43.0	.467
500	.58°	1.0°	46.5	.369

<u>Frequency (Mc/s)</u>	<u>Transmitter Power ** - KW</u>	
	<u>2000 μsec pulse</u>	<u>10000 μsec pulse</u>
100	12500	2500
200	500	100
300	4000	800
400	250	50
500	1750	350

* Maximum radar cross-section values occur at 177 mc/s and at 394 mc/s

** Assumed radar parameters for required power

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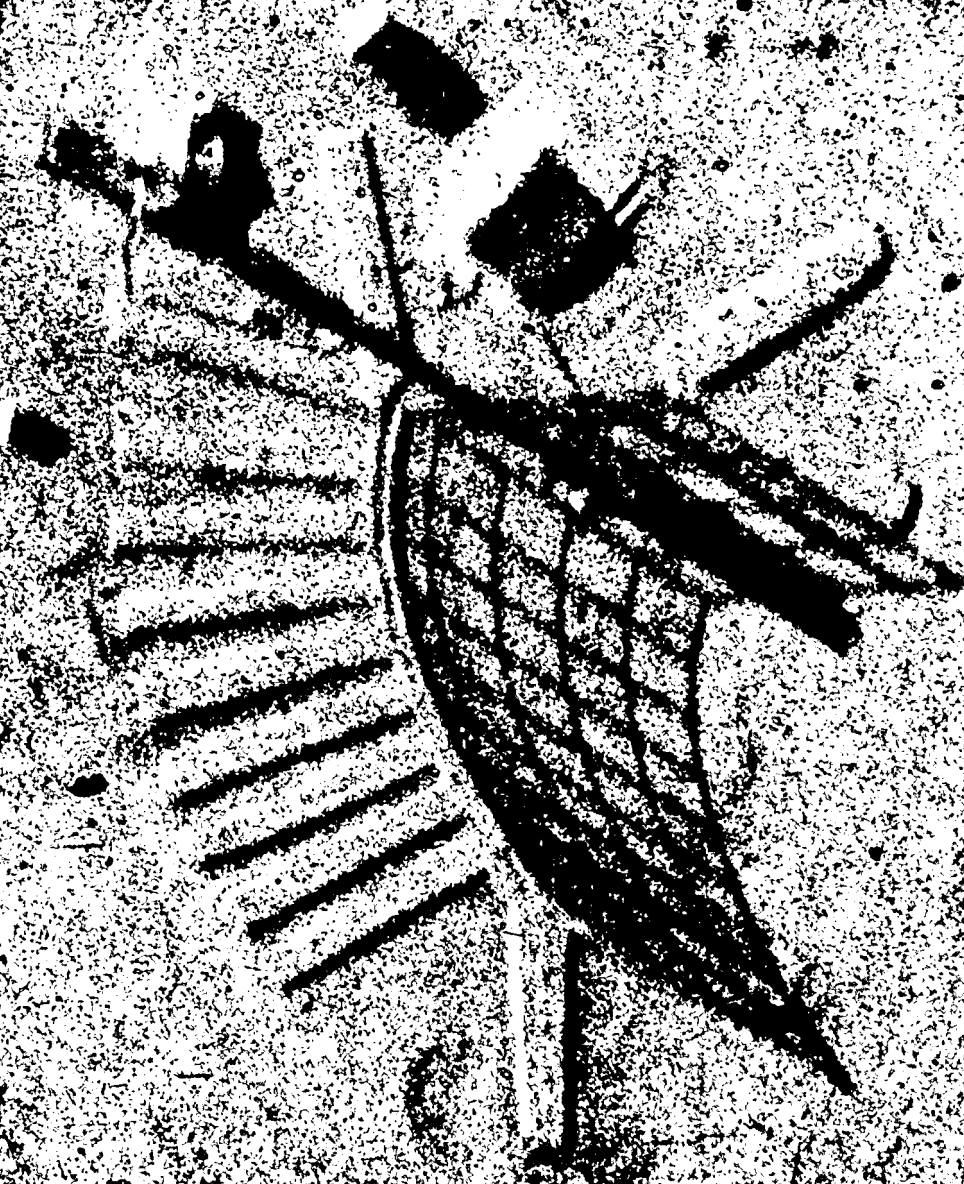


Plate 1. Probable Radar Near
Krasnovodsk, USSR
(30X Enlargement)

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INTERPRETATIVE SKETCH OF PROBABLE RADAR NEAR KRASNOVODSK

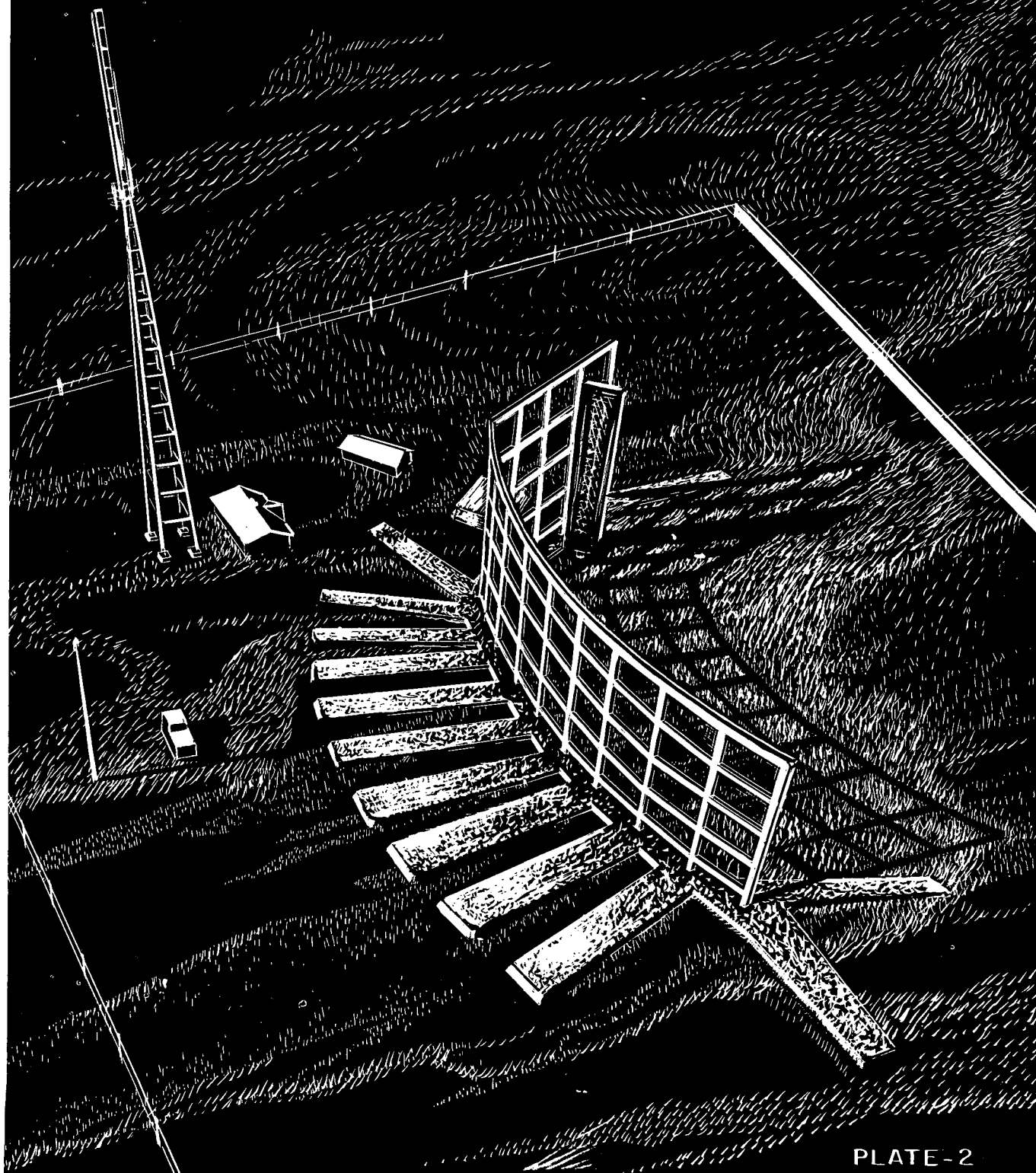


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